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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

LEADER, WILLIAM T

ART UNIT	PAPER NUMBER
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1742

DATE MAILED: 04/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/781,593

Applicant(s)

EMESH ET AL.

Examiner

William T. Leader

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-74 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-74 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 and 6. 6) ☐ Other: ____

DETAILED ACTION

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

Claim Rejections - 35 USC § 102

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-5, 9-12, 14-22, 25-28, 35, 36, 38, 40-43, 45, 53-59, 65-68 and 70-73 rejected under 35 U.S.C. 102(b) as being anticipated by Uzoh et al (5,911,619).

The Uzoh et al patent is directed to method and apparatus for planarizing a metallic layer on a semiconductor wafer. The apparatus includes a polishing pad 64, a platen 62 and a platen electrode 63, which is an electrical conductor, disposed in the platen and connected to the negative terminal of power supply 80. The apparatus additionally includes a workpiece carrier 66 adapted to receive a positive charge from power supply 80 and to press the workpiece against the polishing pad, and drive shaft 68 to turn the platen. See column 5, lines 41-50 and figures 7 and 11a-11b2. Thus, all elements recited in independent apparatus claims 1 and 57 are disclosed by Uzoh et al. Uzoh et al further disclose supplying an electrolytic solution through conduit 72 to a polishing surface of the polishing pad and applying a potential difference between the metallized surface of the

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workpiece and the platen electrode 63 to remove a portion of the metallized surface. See column 5, lines 50-52 and column 4, lines 55-56. Thus, all steps of independent method claim 36 are met. The apparatus may include a plurality of contact elements at least partially disposed in the polishing pad. See column 6, lines 18-20 and figures 11b, 11b1 and 11b2. Thus, all elements of independent apparatus claim 70 and all steps of independent method claim 72 are disclosed by Uzoh et al.

Uzoh et al disclose that the removable cathode contact elements shown in figures 11b, 11b1 and 11b2 may be made of copper mesh (column 6, lines 18-20) which is a low resistance inorganic fiber material as in instant claim 2 and 65. The polishing pad may be made of a conventional soft fabric or hard polyurethane (column 5, lines 57-58) which are insulating materials as in instant claim 3. The polishing pad has sufficient porosity such that an ionic current can flow through the pad to the slurry and to the layer 18 on the workpiece (column 5, lines 59-60) as in instant claim 4. This porosity would provide the fluid communication recited in instant claim 58. As noted above, Uzoh et al provide conduit 72 to supply electrolytic planarizing solution to a polishing surface of the polishing pad as in instant claim 5. The polishing pad 64 may include air gaps (column 6, line 10-14) creating grooves or windows meeting the limitations of instant claims 9 and 10. As noted above, drive shaft 68 turns the platen and polishing pad. The arrow in

Figure 7 shows that the workpiece carrier rotates as does workpiece carrier 36 of the prior art apparatus (column 1, lines 63 and figure 2), meeting the limitations of instant claims 11, 12, 38 and 66. Uzoh et al disclose that the removable cathodes may be made of copper and that the electrode and the platen may be separate parts or may be formed integrally, suggesting the limitation of instant claim 14 that at least a portion of the platen comprises copper.

Suitable slurries for initial and intermediate stages of metal removal include sulfuric acid, hydrogen peroxide, benzotriazole and a non-ionic surfactant in combination with water and silica or alumina (column 4, lines 56-61) suggesting the limitation of instant claims 15, 19-22 and 53-56. The metallized surface to be planarized may be made of copper (column 4, line 44) as in instant claim 16. The removable cathode contacts may be made of copper mesh (column 6, lines 20) meeting the limitation of instant claim 17 which recites inorganic fibers. The pressure applied to the wafer may be in the range of one-half to eight psi (column 4, lines 52-54) overlapping the range recited in instant claims 18 and 43.

Uzoh et al disclose that a variety of electrical waveforms may be applied between the layer 18 and the electrode adjacent the polishing pad. These include steady DC, pulsed DC with a single polarity and pulsed DC with alternating polarity (column 5, lines 9-21 and figure 14) meeting the limitations of instant

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claims 25-27 and 40-42. Uzoh et al disclose that it is known to perform planarization under controlled temperature conditions meeting the limitation of instant claim 28. A more gentle slurry may be used during the final stages of planarization (column 4, line 67 - column 5, line 6) as in instant claims 35 and 45. Any suitable endpoint detection arrangement can be used (column 5, lines 6-7) as in instant claims 67-68.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35

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U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35

U.S.C. 103(a).

5. Claims 6-8, 37 and 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al in view of Yamamoto (5,853,317)

Claims 6-8, 37 and 60 differ from Uzoh et al by reciting that the solution application mechanism comprises at least one channel or conduit formed in the platen through which the electrolytic planarizing solution flows. The Yamamoto patent is directed to a polishing pad and polishing apparatus. As shown in figures 10A and 10B it is known to supply polishing slurry through channels in platen 32 and corresponding openings in polishing pad 30. This is an alternative arrangement to supplying slurry to the top of the polishing pad as shown in figure 7A of Yamamoto and figures 2 and 7 of Uzoh et al. It would have been obvious at the time the invention was made to have supplied the planarizing slurry of Uzoh et al through channels formed in the platen because this supply configuration is an alternative to supply from the top of the polishing pad as taught by Yamamoto.

6. Claims 61-64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al in view of Yamamoto as applied to claims 6-8, 37 and 60 above, and further in view of Berman et al (5,882,251).

Claims 61-63 differ from Uzoh et al by reciting intersecting parallel grooves in the polishing pad. Claim 64 additionally differs by reciting a conduit in the

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platen in fluid communication with a fluid passage in the pad. As noted in the preceding paragraph, Yamamoto discloses polishing slurry channels in the platen and corresponding openings (fluid passages) in the pad as recited in claim 64. The Berman et al patent is directed to a process for polishing a semiconductor wafer using a polishing pad. Berman et al discloses the polishing pad is typically provided with grooves in its polishing surface for slurry distribution and improved pad-wafer contact (column 1, lines 51-53). Figure 2 shows a conventional polishing pad. The pad includes intersecting parallel grooves 130 and slurry injection holes 120 at various intersections of grooves 130 (column 2, lines 1-10). It would have been obvious at the time the invention was made to have utilized a polishing pad in Uzoh et al with intersecting parallel grooves and slurry injection holes in the apparatus and method suggested by the references in the preceding paragraph because slurry distribution would have been improved as taught by Berman et al

7. Claims 13, 39, 69 and 74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al in view of Bibby, Jr. et al (6,106,662).

Claims 13, 39, 69 and 74 differ from Uzoh et al by reciting that the platen is configured to move in an orbital pattern. As noted above, Uzoh et al teach that the platen rotates relative to the wafer being treated but does not specify that the relative motion is in an orbital pattern. The Bibby Jr. et al patent is directed to a polishing method and apparatus in which polishing pad 109 is moved relative to

wafer 103 held in support 101. Instead of the motion of the polishing pad being rotational, the motion of the pad is orbital (column 4, lines 12-13). It would have been obvious at the time the invention was made to have moved the polishing pad of Uzoh et al with an orbital motion rather than a rotational motion because these motions are alternative to each other as shown by Bibby, Jr. et al.

8. Claims 23 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al in view of Tsai et al (5,575,706).

Claims 23 and 44 differ from Uzoh et al by reciting a first and second group of electrical conductors. The Tsai et al patent is directed to a planarization apparatus and process which is enhanced by the application of an electric field between the wafer and platen. In the embodiment shown in figure 3 a pair of electrodes 27 and 28 replace the single electrode shown in figure 2b. This allows tailoring of the polish removal rate as a function of field region and results in improved uniformity of polish removal rate (column 4, lines 37-40). It would have been obvious at the time the invention was made to have included a second group of electrical conductors in Uzoh et al because improved uniformity of removal rate would have been achieved as taught by Tsai et al.

9. Claims 24 and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al in view of Rostoker (5,265,378).

Claim 24 differs from Uzoh et al by reciting monitoring a change in electrical resistance. As indicated above, Uzoh et al disclose that any suitable endpoint detection arrangement can be used. Rostoker discloses a method and apparatus for detecting the endpoint of a polishing process in which a change in resistance across the wafer is sensed. See the abstract. It would have been obvious at the time the invention was made to have utilized resistance in endpoint detection of Uzoh et al because resistance is a convenient parameter to measure as taught by Rostoker.

10. Claims 29-31 and 46-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al in view of Marcyk et al (US 6,121,144).

Claims 29-31 differ from Uzoh et al by reciting cooling the planarizing solution, regulating the temperature of the workpiece carrier with a heat exchange fluid, and regulating the temperature of the platen with a heat exchange fluid. The Marcyk et al patent is directed to a polishing process for semiconductor wafers. Marcyk et al found that with certain materials used in semiconductor wafers, it was desirable to lower the temperature at which planarization was conducted because a more planar surface was obtained (column 2, lines 64-67). The temperature of the slurry may be lowered (column 4, lines 16-20) and heat exchange fluids may be circulated through the wafer holder 320 and the platen 340 (column 3, lines 43-62). It would have been obvious at the time the invention was made to have cooled the slurry, wafer holder and platen in the process and apparatus of Uzoh et al because a

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more planar surface would have been obtained as taught by Marcyk et al.

11. Claims 32-34 and 49-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al in view of Marmillion et al (5,934,977) and Zubak (3,849,272).

Uzoh et al is silent as to the spacing between the platen and metallized surface of the wafer. Claims 32, 33, 49 and 50 differ from Uzoh et al by reciting ranges for the spacing. The Marmillion et al patent is directed to a method of planarizing a workpiece such as a wafer. As in applicant's claimed apparatus and method, the wafer is pressed against a pad supported by a platen. Since both the platen and metallized surface of the wafer contact the polishing pad, the spacing can be no greater than the thickness of the pad. Marmillion et al teach that the pad may be made of a porous resilient material such as polyurethane and may have a thickness of 0.06mm (column 4, lines 48-54). Since the pad is made of a resilient material, the pressure applied during the process would be expected to further reduce the thickness of the pad and the distance between the platen and the surface of the workpiece. The spacing used by Marmillion et al falls within the ranges recited in claims 32, 33, 49 and 50. The Zubak patent is directed to a process for the electrochemical removal of material from a workpiece. Zubak teaches that to improve accuracy it is known to reduce the thickness of the working gap to the utmost (column 1, lines 28-30). It would have been obvious at the time the

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invention was made to have minimized the working gap between the platen and the surface of the workpiece in Uzoh et al to a small value as taught by Marmillion et al and Zubak to improve the accuracy of the material removal.

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The Tzeng patent (5,934,974) discloses a polishing method in which an in-situ sensor measures polishing pads for wear. The Easter et al patent (6,368,190) is directed to an electrochemical mechanical planarization apparatus and method. The Sun et al patent ((6,379,223) is directed to a method and apparatus for electrochemical-mechanical planarization. The Chadda et al (6,464,855) patent is directed to a method apparatus for electrochemical planarization.


Any inquiry concerning this communication or earlier communications from the examiner should be directed to William T. Leader whose telephone number is 703-308-2530. The examiner can normally be reached on Mondays-Thursdays and alternate Fridays, 7:30-4:00.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King, can be reached on 703-308-1146. The fax phone numbers for the organization where this application or proceeding is assigned are

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703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.


William Leader
April 22, 2003


ROY KING
SUPERVISORY PATENT EXAMINER
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